BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Implementation of Section 224 of the Act;	)	WC Docket No. 07-245
Amendment of the Commission's Rules and	)	
Policies Governing Pole Attachments	)	RM-11293
	)	
	)	RM-11303
	)	

DECLARATION OF DONALD E. HOOPER

A. Qualifications

1. My name is Donald E. Hooper. I am an accepted authority on electric supply – communication utility practices and policies, as well as on development and application of the Nation Electrical Safety Code or NESC. I have testified in courts, at administrative hearings and before public utility commissions in Connecticut, Illinois, Kentucky, New Hampshire, New Jersey, New York and Wisconsin, in addition to performing consulting work in these and several other states. My experience is based on over 40 years of employment with Public Service Electric and Gas Company, a major investor-owned electric and gas utility located in New Jersey; 39 years of active involvement with the NESC; and consulting work in the electric supply – communication field since 1989. At the present time, I am Chairman of the NESC Interpretations Subcommittee and member of the Coordinating Subcommittee, Overhead Lines – Clearances Subcommittee and WG 4.12 (appointed to review and recommend revisions

to Rules 235 and 238 for the 2012 Edition). Details of my experience are covered in my CV. See Attachment A.

B. Overview

2. I am aware that Time Warner Cable ("TWC") and Oncor Electric Delivery ("Oncor") have been discussing NESC issues for some time. In connection with these discussions, I have been advised by TWC that Oncor has accused TWC of creating NESC violations on Oncor poles and of allowing its workers to work in unsafe environments by, among other things, overlashing cables to attachments in situations where Oncor poles contain NESC violations. TWC asked me (1) to advise it regarding the NESC requirements that might apply to overlashing situations, (2) to review and analyze Reply Comments filed with the Federal Communications Commission in WC Docket No. 07-245 on April 22, 2008, in which Oncor attached various photographs and accused TWC of creating violations of the NESC and working in violation of the NESC work rules, (3) to conduct a field inspection of some Oncor poles in Dallas used for Broadband Over Powerline ("BPL") service in August 2007, and (4) to conduct a further field inspection of Oncor poles in Dallas more broadly in May 2008 to determine if Oncor's poles contain NESC violations and to try to determine whether Oncor or other attaching parties created the violations found. This Declaration sets forth my findings and analysis related to these requests.

C. Basic Clearance and Work Practice Requirements

3. The NESC specifies in Rules 235 and Table 235-5 vertical clearance requirements between electric supply ("supply") and communication facilities installed on poles. The basic requirement for separation between supply conductors and

communication cables is 40" at the pole and 30" in the span. A reduced clearance of 30" at the pole and 12" in the span is allowed where the power facilities are neutral conductors. This 40" or 30" vertical clearance at the pole, known as the Communication Worker Safety Zone ("CWSZ"), is necessary to provide both a clear delineation between supply and communication facilities and room for communication workers to work safely. See NESC Rule 235 and Table 235-5. (A copy of the relevant portions of the NESC is attached to this Declaration as Attachment B.)

4. Similarly, underground supply service risers on poles must be protected with conduit or covering (U-guard) to 40" above the highest communication attachment. Also, ungrounded guys in the supply space must have the same clearance from communication facilities as the supply conductors to which they are exposed: a minimum of 40". *See* NESC Rule 239G1.

5. Fiber-optic cables can be installed in either the supply or the communication space. However, these cables cannot transition between the supply and communication space in a span between the poles; such transitions must be made in a vertical run on a single pole. All dielectric fiber cables, commonly known as ADSS cables, in the supply space must have the same 30" clearance to communication cables as required for a neutral conductor. (Dielectric fiber is non-conducting.) Fiber cables of any type in the communication space must have the same clearances to supply conductors as any communication cable: 40" normal or 30" to a neutral conductor. New fiber cables placed in the communication space must also have 12" spacing from other communication cables. *See* NESC Rules 224A2, 224A3c, 230F1b, and 230F2.

6. The NESC also specifies work practice requirements. Communication workers must observe two limitations when working on jointly used poles (or on communication facilities attached to such poles). See NESC Rule 432 and Table 431-1. Communication workers must not:

- Approach energized electric conductors or cables closer than the distances specified in Rule 432 and Table 431-1. The specified distance for secondary supply conductors (51 to 300 Volts) simply requires the communication worker to "avoid contact" with the supply conductors. This means that communication workers are permitted to work around energized secondary conductors so long as they can "avoid contact" with those conductors.
- Position themselves above the level of the lowest electric conductor **exclusive of vertical runs and street lighting** (emphasis added). What this means is that communication workers should not work above the lowest horizontal electrical conductor. This requirement does not prevent a communication worker from working below a transformer lead, even if that lead violates the NESC clearance requirements, so long as the worker can "avoid contact." It also does not prevent a communication worker from working along side a vertical supply conductor that is not covered by a U-Guard, again so long as the worker can "avoid contact" with the conductor.

D. Oncor's Reply Comments to the FCC

7. At TWC's request, I have reviewed Oncor's Reply Comments and the photographs attached by Oncor. I am aware that TWC requested on April 24, 2008, that Oncor provide by April 28, 2008, the locations of the photographs so that they could

promptly be reviewed by TWC. I am also aware that Oncor did not provide that information until late in the afternoon of May 15, 2008. See Attachment C. Although I visited Dallas for a field inspection (as described more fully below) on May 13-15, 2008, I had left Dallas by the time Oncor provided that information by email to TWC's counsel. I was prepared to review the situations depicted in the photographs in Dallas during my field inspection but was unable to do so because Oncor took two and one-half weeks to provide the pole locations.

8. Even without having an opportunity to review in the field the poles depicted in the photographs, however, based on the photographs themselves, a number of things are apparent.

9. Oncor states at page 8 of its Reply Comments, referring to the top-left photograph on page 9 that TWC: "... has allowed a contractor to overlash a TWC facility that **actually runs directly through several secondary leads connected to Oncor's transformers**" (emphasis as in Oncor Reply Comments). Note that this appears to be the same location as shown in photo 15, attached to the Declaration of Wilfred Arnett, taken from a different direction. Oncor appears to argue that TWC should not be allowed to overlash its existing cable on this pole due to the NESC violation (open vertical secondary cables not protected to 40" above the TWC attachment). While the Oncor unprotected cables present an obstacle, **NESC rules do not prohibit TWC from working on its cable, including overlashing, as long as contact with the vertical Oncor cables is avoided.** Note that the unprotected Oncor cables, in this instance, also create violations to two ILEC cables. (I have been advised that a TWC employee saw this contractor working without his hard hat on March 27, 2008, the same day that Oncor took

the photographs and fired him the next day – several weeks before Oncor notified TWC of its own knowledge of the situation.)

10. Oncor admits that its own workers created the NESC violation and stated that it has ordered immediate remediation work. See page 10. (I am advised by TWC that Oncor did not actually correct the situation until approximately April 29, 2008, more than a month after the date on the photograph (March 27, 2008)). Similar situations are shown in other photos attached to Mr. Arnett's Declaration. Oncor's intentions regarding correcting these situations are not known. See photos 1 and 11. I am advised that as of May 27, 2008, Oncor had not remediated any of the situations on poles that could be located by TWC except for the one corrected on April 29. (I am also advised that the few situations that were caused by TWC's contractors, having to do primarily with temporary situations during overlashing projects, have been corrected by TWC.)

11. Next, Oncor shows a small photo of a communication worker, stating that he is: "...working so close to Oncor's secondary power conductor that he could not possibly be respecting the NESC and Oncor mandated 40" CWSZ." See text and lower photo on page 9. See also photo 19. Yet the photo does not support the stated complaint. Rather, it does just the opposite. **It shows the worker as he would normally be positioned while working on a communication attachment and working in accordance with NESC work rules.** Note that the top of the worker's hard hat may appear to be at the same level as the lower Oncor cable. However, taking perspective into account, it is obvious that the worker is below the Oncor cable.

12. Finally, Oncor states that the former situation, (top left photo, page 9 and photo 15), would have been discovered and corrected before any overlashing took

place had TWC submitted the appropriate prior notice to Oncor. See page 10. Yet I understand that in discussions with TWC about overlashing Oncor has refused to agree to any time period for correcting existing violations, and as noted earlier and later in this Declaration, Oncor's actions in correcting NESC violations of which it has become aware are often extremely delayed. Consequently, cable operators, such as TWC, cannot wait for utilities to fix existing NESC violations (often caused by the utilities themselves) before overlashing, when the overlashing can be accomplished without creating any new NESC violations or violating the NESC work rules. **Overlashing fiber-optic cable to existing plant does not, in itself, create new clearance violations, nor does it make remediation of existing violations more difficult.** And as discussed above, overlashing can often be accomplished even in situations where there is an existing NESC violation without violating the NESC work rules.

(Arnett Declaration) Photos

13. The photos attached to Mr. Arnett's Declaration are characterized, as shown in the underlined section headings.

<u>Violations CATV/ILEC</u>

14. Photos 1 and 2 (same location). This is plainly an Oncor-caused violation because the electric supply cables in the CWSZ are not protected (in conduit or covered by U-guard). It appears that this violation existed before the "CATV" overlashing; overlashing did not cause the violation. In addition, it is likely that the Oncor facilities causing the violation were installed after the original cable attachment. Finally, the "Power Space" designation in the photo is incorrect. According to Oncor, these photos were taken by or on behalf of Oncor on March 27, 2008. See Attachment C.

I am advised by TWC that until Oncor filed its Reply Comments and later provided information on the location of the photo on May 15, 2008, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. I am advised that as of May 27, 2008, Oncor still had not corrected the violation.

15. Photo 3. This photo does not show the alleged violation because of the background interference. Again, the secondary drip loops to the transformer may have been installed after the original cable attachment. According to Oncor, the photo was taken on April 3, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. I am advised that TWC personnel have looked for this pole but have not been able to locate it, based on the vague location description provided by Oncor.

16. Photo 4. This is a similar situation to that shown in photo 3; see prior comments and photo 4:

- Violation apparently existed before overlashing, not caused by overlashing.
- Oncor facilities causing violation likely installed after the original TWC attachment.
- Power space incorrectly designated.
- Also, Oncor facilities appear to be in violation with upper ILEC attachment.

According to Oncor, the photo was taken on April 3, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments and later provided information on the location of the photo on May 15, 2008, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. Again, I am advised that, as of May 27, 2008, Oncor had not corrected the violation.

17. Photo 5. The statement associated with this photo alleges that the "Flying Attachment" is improper construction. The photo does not substantiate the statement; additional field inspection is required to determine if the statement is valid. According to Oncor, the photo was taken on March 19, 2008. See Attachment C. According to TWC engineering personnel, this appears to be a situation where the pole was moved back after TWC's facilities were attached. TWC is currently considering how best to resolve this situation. .

18. Photo 6. This photo shows a violation; see prior comments:

- Violation appears to have existed before overlashing, not caused by overlashing.
- The Oncor transformer appears to have been installed after the original TWC attachment.
- Also, it appears that TWC could lower its attachment to clear the transformer upon request by Oncor. Assuming that the Oncor transformer is the cause of the cited violation, Oncor should have requested TWC to lower prior to installing the transformer.

According to Oncor, the photo was taken on April 3, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments and later provided information on the location of the photo on May 15, 2008, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. Again, I am advised that, as of May 27, 2008, Oncor had not corrected the violation.

19. Photo 7. This photo shows an NESC violation on the span. While not certain, it appears to be an Oncor-caused violation due to the slack span. Also, it is likely that the Oncor cable was installed after the original TWC attachments. According to Oncor, the photo was taken on April 11, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. TWC has been unable to locate this span due the vagueness of the location description – which covers a wide area.

20. Photo 8. This photo shows a violation but is not clear enough to determine the cause. It appears, however, that the Oncor secondary wire has excess sag and since the transformer installation appears relatively new, it is likely that the Oncor secondary wire caused the violation. According to Oncor, the photo was taken on April 11, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. TWC has been unable to locate this span due the vagueness of the location description – which covers a wide area.

21. Photo 9. Oncor should repair the "damaged" secondary cable. The photo does not demonstrate that the "damage" was due to CATV overlashing. Nor does the photo show that overlashing of TWC's cable in the circumstances violated the NESC work rules. According to Oncor, the photo was taken on April 11, 2002. See

Attachment C. I am advised by TWC that until Oncor filed its Reply Comments TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. TWC has been unable to locate this span due the vagueness of the location description – which covers a wide area.

22. Photo 10. This photo shows a violation similar to photo 8; see photo 8 comments. Again, TWC has been unable to locate this span due the vagueness of the location description – which covers a wide area.

<u>Overlashing = Real burden on pole</u>

23. Photo 11. This photo shows an NESC violation due to unprotected vertical secondary conductors, similar to photo 1. See comments on photo 1, except for marking of "Power Space." According to Oncor, the photo was taken on April 11, 2002. See Attachment C. I am advised by TWC that until Oncor filed its Reply Comments, TWC had no knowledge of this violation. Oncor has still provided no formal notice to TWC about the violation or made any suggestion about how it should be remediated. Again, TWC has been unable to locate this span due the vagueness of the location description – which covers a wide area.

24. Photo 12. This photo also shows a CATV bundle but does not support the alleged complaint of "excessive strain on pole."

<u>Overlashing creates real safety and reliability issues</u>

25. None of the photos in this section demonstrate any issue regarding reliability.

26. Photo 14. This photo shows a contractor, working at the communication (CATV) level, not wearing a hard hat. Not wearing a hard hat is a direct violation of both NESC and OSHA work rules. I understand that TWC also found this worker in a similar situation on the same day, March 27, 2008, and immediately had the worker fired. The TWC action was taken before receiving any notice from Oncor. I understand that TWC was not notified by Oncor of this contractor's violation of safety rules until April 15, 2008..

27. This photo also equates the uninsulated bucket truck to a shock hazard. This is a false statement. Communication workers normally use uninsulated trucks; the uninsulated bucket truck is the communication industry standard and is not in violation of any safety code or standard. Oncor's statement demonstrates a major lack of knowledge or misunderstanding of communication work rules and practices.

28. Photo 15. This appears to be the same location as the photo shown on page 9 of the Reply Comments. See my comments in paragraphs 9, 10 and 12 of this Declaration Also, note that the "Power Space" is not correctly identified. I am advised by TWC that Oncor corrected this violation on or about April 29, 2008, more than a month after Oncor took the photograph of the violation. Oncor has admitted in its Reply Comments that it caused the violation.

29. Photo 16. The photo states that the contactor is entering power space and equates the action to an NESC and OSHA violation. The statement is false; the worker is positioning himself at the CATV attachment level. Also see my discussion of similar circumstances in paragraphs 11, 26 and 27 of this Declaration.

30. Photo 17. This is the same photo as shown on page 9 of the Reply Comments and. as noted before, appears to be the same location as photo 15. Unlike the photo on page 9 and photo 15, photo 17 alleges that the CATV worker is "working in the power space" and equates this action as an NESC violation. This statement is false; the CATV worker is at the communication level working in accordance with the NESC work rules. The statement "uninsulated truck, no gloves" is, at best, misleading; relating it to an NESC violation is false. See prior comments at paragraphs 9, 10, 12 and 28. Note that the "Power Space" is, again, incorrectly identified in photo 17.

31. Photo 18. This is the same situation as shown in photo 17 and may be the same location. See my comments at paragraph 30.

32. Photo 19. This is the same photo as shown on page 9 in the Reply Comments. See my comments in paragraph 11. Note that the "Power Space" has been correctly identified in photo 19.

Temporary Attachments

33. Photo 20. This is the same photo shown on page 20 of the Reply Comments, where it is identified as: ". . . a TWC contractor's solution to not being finished with an overlashing project at quitting time." While this may not be the best work practice, there is no evidence that the coiled fiber is: ". . . causing excessive strain on poles," as Oncor stated in the photo 20 caption. I am advised that this situation, created by TWC's contractor, does not meet TWC's requirements and that it has been corrected by TWC.

34. In the text, the photo accompanies Oncor's statement regarding the Fibertech position on temporary attachments, asking if this (photo 20) is a temporary

attachment. It should be noted that Fibertech is requesting temporary pole attachments, not the temporary work practice illustrated in photo 20. See page 20 of the Oncor Reply Comments.

35. Photo 21. Again, this photo shows temporary fiber coils apparently left overnight by the contractor. This is a technical NESC ground clearance violation. However, it does not appear to be hazardous as it is unlikely that anyone would walk into an obvious walking space obstruction. Again, I am advised by TWC that this situation no longer exists.

36. Photo 22. This photo shows two situations: an alleged incomplete overlash and a guy wire installed but not anchored. While the photo does not include sufficient information to fully analyze these situations, it does not appear that the pole is overstressed. I am advised by TWC that the incomplete overlash was the result of TWC waiting until a fiber splice was tested, after which the overlash would be completed. The slack guy is apparently due to its having been hit by a vehicle. After learning the location of this situation, TWC has had someone go and reconnect the guy to the existing anchor.

37. Photo 23. This photo alleges excessive overlash spools left on the pole. Again, there is insufficient information to fully analyze the situation. Nevertheless, I am advised by TWC that the situation, created by a contractor, is not consistent with its standards and will not be tolerated.

E. Dallas Field Inspection on August 29-30, 2007

38. In the Summer of 2007, I was requested by TWC to conduct a field inspection of poles in the Dallas area to determine the extent and type of any clearance problems involving new TWC overlashed fiber cable as well as any similar problems

with Oncor BPL or fiber cable facilities. The inspection was to cover a relatively small area, specific routes were to be selected by TWC personnel, and the resulting survey was not intended to be a random sample.

39. I conducted this field inspection in the west-Dallas area on August 29 and 30, 2007. The areas selected by TWC had been scheduled for upgrade, overlashed cable had been installed, but the fiber cable had not yet been placed in service at the time of the field inspection (the upgrade had not been completed). In these same areas, Oncor had been installing both BPL and fiber cable facilities at about the same time that TWC was installing its overlashed fiber cable. During the inspection, I took photos at documented locations. See Attachment D.

40. As to the BPL system, I observed that Oncor had installed a medium-voltage coupler device ("MVC") connected to an open-wire primary conductor and a communications device ("CD") connected to the secondary conductors at each transformer location where service is intended to be provided. Both devices are mounted on the same pole and connected by a coax cable; both devices also appear to be grounded at the pole. See photos 1 and 2.

41. I also observed that the Oncor fiber was ADSS cable and that most of its cable system had been placed in the supply space. However, some of the attachments do not have the required clearance to existing communication facilities. These installations cannot be construed as being in the communication space because the transitions are in the span and clearance to electric supply conductors is less than would be required by the NESC.

42. While TWC advised me that it understands that the BPL and fiber systems are being installed for different purposes, I observed one instance where the two systems appear to be interconnected.

43. I observed many clearance violations during the field inspection and documented 24 typical violations on 15 poles. Most violations involved insufficient separations between Oncor and TWC facilities, although some related to Oncor-AT&T. Almost all of the violations could be clearly attributed to Oncor (Oncor-caused). While it was not clear which party may have caused two of the violations, it did appear that one of these was due to a new Oncor installation. If so, this would also be an Oncor-caused violation. Almost one-third of the violations were due to new Oncor installations – either BPL or fiber cable.

44. Detailed observations for the documented locations are:

- <u>2816 Ripplewood.</u> Oncor's CD drip loops are only 22" above TWC; 40" is required. This is an Oncor-caused violation. See photo 3.
- <u>Northwest Highway, first pole w/o Solta.</u> This appears to be a connection between Oncor's BPL and fiber systems at the fiber enclosure. As to clearance, the coil from the Oncor CD is 29" above TWC; 40" is required. This is an Oncor-caused violation.
- <u>1451 John West (west side of Methodist Church).</u> There are two violations at this pole. First, an Oncor open-wire secondary conductor (120-volt feed to school signal riser on corner pole) is 32" above TWC; 40" is required. While this is a joint Oncor-TWC problem, it appears that Oncor can raise the conductor. Second,

Oncor's new fiber cable is installed 22" above TWC; 30" is required. This is an Oncor-caused violation. See photo 4.

- Mockingbird Lane and Hillgreen Drive. There are two pole-clearance and one span-clearance violations at this location. First, Oncor's new triplex cable, as evidenced by the shiny dead-end clamp, is 29" above TWC; 40" is required. Second, Oncor's new fiber cable is 23" above TWC; 30" is required. Third, Oncor's new fiber cable sags below both TWC and AT&T in the span; 12" is required above the highest communication (TWC) in the span. These are all Oncor-caused violations. See photos 5 and 6.

- Lakeland Drive and Hunnicut Road. This is a relatively new pole replacement with two Oncor fiber cables attached at the proper height above TWC. However, a new Oncor triplex cable is only 17" above TWC; 40" is required. The triplex could not have been transferred from the old pole which was approximately three feet to the east (the triplex runs west). This is an Oncor-caused violation. See photo 7.

- Lakeland Drive and Sweetwood. This is close to the prior location. Again, Oncor's new triplex is 27" above TWC; 40" is required. This is an Oncor-caused violation. See photo 8.

- Northwest Highway, west side of pole 6N6E214 This is a relatively new pole replacement with an incomplete transfer. The new pole, placed within the past year, does not have adequate height for the existing facilities. The lower neutral conductor is 27" above TWC; 30" is required. Oncor's new fiber cable, which may have been installed after the new pole was set, is 23" above TWC; again 30" is required. TWC cannot lower because AT&T would not have sufficient attachment height to maintain clearance above the adjacent driveway. Based on tag and brand, the old pole was reinforced in 2003 and the new pole was set after August 2007. These are Oncor-caused violations. See photo 9.

- Northwest Highway and Mediterranean. Again, this is a pole replacement without adequate height for existing facilities to be transferred to the new pole. The new pole was set within the last six months; neither TWC nor AT&T has yet transferred. Due to the installation of a new Oncor CD and fiber cable, it appears that neither TWC nor AT&T will have room to attach to the new pole (but would have had room without the new Oncor facilities). This is an Oncor-caused violation. See photo 10.
- 1516 John West. Oncor's transformer lead drip loops are 34" above TWC due to excessive length; 40" is required. While this is an Oncor-TWC problem, it appears that Oncor installed the transformer after TWC attached to the pole and that Oncor can easily correct this situation. See photo 11.
- John West, pole 2N7E686. This is an underground service to a new AT&T U-Verse installation, made within the last six months. The riser conduit ends 15" above TWC and the service cable above is not covered; covering to 40" above TWC is required. This is an Oncor-caused violation. Oncor can remediate either by extending the conduit or by installing U-guard. Note that both the new triplex and fiber cables have adequate clearance to TWC. See photo 12.
- Mediterranean, first pole n/o Northwest Highway. This is another underground service to a new communications facility, an AT&T VRAD. In this case, the riser

conduit ends 23" above TWC. As before, the service cable must be covered to 40" above TWC. This is an Oncor-caused violation. See photo 13.

- Dilido, pole 2N7E42. This is a third Oncor underground service with the conduit ending less than 12" above TWC and no covering over the service conductors; covering to 40" above TWC is required. This is an Oncor-caused violation. See photo 14.

- Northwest Highway, first pole w/o Lullwater Drive. This is an underground service riser with drip loops that do not have adequate clearance to communication facilities. Required vertical clearance to each communication cable attachment is 40"; actual clearances are listed below. Note that only the lowest AT&T cable has adequate clearance. Clearance violations to the other communication attachments are Oncor-caused. See photo 15.

AT&T guy	4"
TWC	13"
Highest AT&T	27"
Middle AT&T	28"
Lowest AT&T	40"

- Norris between Ravendale and Mockingbird Lane (five poles – four spans). This is an Oncor four-span pole-to-pole guy wire (guy strand) that does not appear to be connected to any other conductor or to ground. It transitions between the primary and the communication space, at the pole top between the primary crossarm and braces on the pole at Ravendale to approximately 3" above TWC on the pole at St. Moritz. As an isolated guy wire, it must have the same clearance to communication facilities as primary open-wire, or 40" at each pole. This is a series of Oncor-caused violations to both TWC and AT&T cable attachments. See photos 16 – 20 inclusive.

45. I am advised that TWC provided a preliminary report of my findings (including the pole locations and descriptions of the NESC violations) related to this field inspection to Oncor on approximately January 18, 2008.

46. As part my more recent field inspection on May 13-15, 2008 (described in more detail below), I returned to review the situations identified by me in my earlier inspection, described immediately above. I found that Oncor has not corrected **ANY** of the NESC violations identified in my preliminary report, despite having information about the violations for approximately five months. I did find that TWC had transferred to a new pole at Northwest Highway, west side of pole 6N6E214. However TWC does not have required clearance on the new pole to either neutral or fiber cable. At another location, the guy running along Norris is bonded to the pole grounding conductor at Mockingbird Lane; the guy is not in violation. The bonding connection does not appear to be new; it was apparently missed during the 2007 field inspection.

F. Dallas Field Inspection on May 13-15, 2008

47. TWC requested that I survey portions of the greater-Dallas area in response to allegations made by Oncor in its Reply Comments to the FCC dated April 22, 2008, and I conducted a field inspection on May 13-15, 2008. Although TWC had requested on April 24, 2008, that Oncor provide the locations of the photos included in its Reply Comments by April 28, 2008, Oncor had not yet done so at the time of my inspection. Accordingly, I was not able to review most of these locations in the field inspection.

these locations in the field inspection. Instead, I visited several areas of Oncor's service area to get a general idea of what NESC violations existed in the field and who caused them. As I drove out those portions of the system, I selected locations for inclusion in this report that depicted typical Oncor-TWC clearance violations. I also reviewed the status of the violations I found in my August 2007 field inspection.

48. I found many Oncor-TWC vertical clearance violations and documented typical violations at 17 pole and mid-span locations. I also noted Oncor-third party violations at some of these locations. All of the Oncor-TWC violations appeared to be Oncor-caused; many can be directly attributed to Oncor. Photos showing the NESC violations and a listing of violations types, noting the parties responsible, are contained in Attachment E. I understand the photos and information as to the location of the poles was provided to Oncor on June 5, 2008. See Attachment F.

The foregoing information is true and correct to the best of my information and belief and is provided under penalty of perjury.

Donald E Hooper | June 18, 2008

Donald Hooper | Date

Attachment A

DONALD E. HOOPER - RESUME

Graduated from Yale University in 1947 with a Bachelor of Engineering degree; elected to Tau Beta Pi. Also graduated from the Public Service Electric and Gas Company (PSE&G) Power Systems Engineering course in 1958 and the University of Michigan Public Utility Executive Program in 1962.

Accepted employment with PSE&G immediately following graduation. Continued with PSE&G in an advancing series of engineering and management positions for over 40 years until retirement in 1988. Experience included both overhead and underground electric distribution and subtransmission design, construction, operation and maintenance through 69kV; and overhead transmission design, operation and maintenance through 500kV. Experience covered both field and general office work and responsibility. PSE&G is a major company in the utility field, one of the largest investor-owned electric/gas utilities in the United States.

Involved in development of national codes and standards since 1969, representing both the Association of Edison Illuminating Companies (AEIC) and the Edison Electric Institute (EEI) on various National Electrical Safety Code (NESC) and metric committees until retirement from PSE&G. Continues to serve on NESC groups as an individual member.

Started consulting business after retirement from PSE&G; incorporated as ES&C in 1995.

At the present time, active as follows:

- Chairman, NESC Interpretations Subcommittee
- Member, NESC Coordination Subcommittee
- Member, NESC Overhead Lines - Clearances Subcommittee
- Senior Member, Institute of Electrical and Electronic Engineers
- Member, National Fire Protection Association
- Consultant, in areas of electric supply, communications and NESC

Consulting and PSE&G experience is summarized on pages 2 and 3, codes and standards activities on page 4.

CONSULTING EXPERIENCE

1989 through 1994 Operated as Sole Proprietor

1995 to Present Organized as ES&C, Inc.

1989 to Present Provide consulting services to the electric supply and communication industries, including studies, opinions, seminars and expert witness testimony.

PSE&G EXPERIENCE

Employed by PSE&G (New Jersey) from 1947 to 1988.

Aug 1978 through Jan 1988 Ass't to Vice President-Transmission and Distribution

Executive position: provide direction for both electric and gas transmission and distribution (T&D) activities. Significant accomplishments include:

- Develop and manage Customer Service Improvement Program (Quality Work).
- Edit and publish *Inside T&D*, the T&D Department newsletter serving over 5600 employees (>40% of PSE&G total employment).
- Contribute to national codes and standards activity.
- Develop and manage PSE&G vanpool program, 1980 through 1986, with 50 operating vanpools by 1986.

July 1977 through July 1978 Ass't to Manager-T&D Engineering

Technical executive position: provide technical direction for electric T&D activities. National codes and standards activity continued during this period.

Jan 1964 through June 1977 Distribution Plant Engineer

Engineering position: manage and provide technical direction for general office design group. National codes and standards activity started during this period. Other significant accomplishments include:

- Develop 13kV distribution design standards based on gloving work practice.
- Develop 13kV distribution systems with loop feed, automatic reclosers and automatic throw-over.
- Develop supervisory control and data acquisition systems (SCADA) and apply to 13kV distribution.

Feb 1961 through Dec 1963 Street Lighting Engineer

Engineering position: manage and provide technical direction for general office design group. Significant accomplishments include:

- Develop standards for ornamental wood poles--to become national commercial standard.
- Develop, with suppliers, reliable and inexpensive street light photocontrols. This development led to practical and economical industry conversion of series street lighting to multiple.
- Develop PSE&G private (dusk-to-dawn) lighting program.

July 1949 through Jan 1961 Assistant Engineer, Associate Engineer, Engineer

Field engineering positions: plan distribution system expansion; design both overhead and underground distribution systems; direct construction and installation of distribution facilities; direct distribution system operations. Significant accomplishments include:

- Field application of switchable capacitor voltage control system.
- Develop, design and install underground network service to a major metropolitan shopping center.
- Design and install fixed capacitor VAR supply in underground network system.

June 1947 through June 1949 Cadet Engineer

Participate in company-wide training and development program.

ENGINEERING PAPERS

1987 *EEI's Standards Participation Program*: paper presented to EEI Standards Coordinator's Participation Workshop, October 7, 1987, Washington, DC.

1987 *Representing National Groups, Government and Companies on Committees and IEC Technical Advisory Groups*: paper presented to American National Standards Institute Seminar on Working Toward Consensus in National and International Standardization, March 26, 1987, Arlington VA.

1967 *Bolometer Detects Defective Splices*: published *Electric Light and Power*, November 1967.

1967 *Bolometer Detection of Defective Splices*: paper presented to Pennsylvania Electric Association, January 11, 1967, York, PA.

1964 *Spacer Cable, Reclosers Stormproof 13kV System* published *Electrical World*, November 30, 1964.

NATIONAL CODES AND STANDARDS EXPERIENCE

Contribute to development of the NESC as follows:

1983 to Present Interpretations Subcommittee; member 1983 through 1990, Chairman beginning Jan 1991. This subcommittee reviews public requests for interpretation of specific portions of the NESC and develops official responses. Interpretations are published periodically; last publication covered 1993-1995.

1995 to Present Member, Coordination Subcommittee (SC1).

1978 to Present Member, Overhead Lines-Clearances Subcommittee (SC4). Represented EEI from 1978 to 1988; continued to serve as an independent member after retirement from PSE&G. Chaired EEI activity and proposal to coordinate overhead line clearance values, resulting in significant changes in the 1984 Edition and further refinements in the 1987 Edition of the NESC.

2005 to Present Member, Working Group 4.12, Revise Rules 235 and 238.

1998 to 2000 Member, Working Group 4.8, Aerial Facilities Clearance Review. This group conducted a comprehensive review of overhead clearance requirements between supply and communication facilities and revised the definition of communication lines.

1998 to 2000 Member, Working Group 4.10, New Ice Loads and Clearances. This group reviewed pending changes in the ice-loading map, considered affected clearance rules, and developed appropriate clearance rules.

1991 to 1996 Chairman, Working Group 4.4, Revision of Rule 239. This group reviewed Rule 239 and developed proposals to revise the Rule for consistency and clarity. The proposed revisions were adopted in the 1997 Edition.

1987 to 1990 Member, Working Group 4.2, Uniform Clearances. This group developed a method to state clearance values at minimum rather than normal conditions; the method was adopted in the 1990 Edition. This change also moved the NESC from a design manual approach to a performance standard with simplified code language.

1969 to 1977 Member, Definitions, General and Miscellaneous Subcommittee, representing AEIC. This Subcommittee reviewed and revised subject portions of the NESC, the first major revision since the Sixth Edition (1960).

Other national codes and standards activities include:

1980 to 1988 EEI Metrication Committee; charter member 1980 to 1988, Vice Chairman 1982-83, Chairman 1983-85.

1977 to 1983 Member, American National Metric Council Electrical Goods Sector Committee, representing AEIC.

Donald E. Hooper 5/1/2006

Attachment B

Accredited
Standards
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C2-2007

National Electrical Safety Code®

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

Approved 20 April 2006
Institute of Electrical and Electronics Engineers, Inc.

Approved 16 June 2006
American National Standards Institute

2007 Edition

Abstract: This standard covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The standard is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This standard consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 2007 Edition of the National Electrical Safety Code.

Keywords: communications industry safety; construction of communication lines; construction of electric supply lines; electrical safety; electric supply stations; electric utility stations; high-voltage safety; operation of communications systems; operation of electric supply systems; power station equipment; power station safety; public utility safety; safety work rules; underground communication line safety; underground electric line safety

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1 August 2006 SH95514

224. Communication circuits located within the supply space and supply circuits located within the communication space

A. Communication circuits located in the supply space

1. Communication circuits located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space in accordance with the applicable rules of Sections 42 and 44.

2. Communication circuits located in the supply space shall meet the following clearance requirements, as applicable:

   a. Insulated communication cables supported by an effectively grounded messenger shall have the same clearances as neutrals meeting Rule 230E1 from communication circuits located in the communication space and from supply conductors located in the supply space. See Rules 235 and 238.

   b. Fiber-optic cables located in the supply space shall meet the requirements of Rule 230F.

   c. Open-wire communication circuits permitted by other rules to be in the supply space shall have the same clearances from communication circuits located in the communication space and from other circuits located in the supply space as required by Rule 235 for ungrounded open supply conductors of 0–750 V.

   EXCEPTION: Service drops meeting Rules 224A3a and 224A3b may originate in the supply space on a line structure or in the span and terminate in the communication space on the building or structure being served.

3. Communication circuits located in the supply space in one portion of the system may be located in the communication space in another portion of the system if the following requirements are met:

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a. Where the communication circuit is, at any point, located above an energized supply conductor or cable, the communication circuit shall be protected by fuseless surge arresters, drainage coils, or other suitable devices to limit the normal communication circuit voltage to 400 V or less to ground.

NOTE: The grades of construction for communication conductors with inverted levels apply.

b. Where the communication circuit is always located below the supply conductors, the communication protection shall meet the requirements of Rule 223.

c. The transition(s) between the supply space and the communication space shall occur on a single structure; no transition shall occur between line structures.

EXCEPTION: Service drops meeting Rules 224A3a and 224A3b may originate in the supply space on a line structure or in the span and terminate in the communication space on the building or structure being served.

d. The construction and protection shall be consistently followed throughout the extent of such section of the communications system.

B. Supply circuits used exclusively in the operation of communication circuits

Circuits used for supplying power solely to apparatus forming part of a communications system shall be installed as follows:

1. Open-wire circuits shall have the grades of construction, clearances, insulation, etc., prescribed elsewhere in these rules for supply or communication circuits of the voltage concerned.

2. Special circuits operating at voltages in excess of 90 V ac or 150 V dc and used for supplying power solely to communications equipment may be included in communication cables under the following conditions:

   a. Such cables shall have a conductive sheath or shield that is effectively grounded, and each such circuit shall be carried on conductors that are individually enclosed with an effectively grounded shield.

   b. All circuits in such cables shall be owned or operated by one party and shall be maintained only by qualified personnel.

   c. Supply circuits included in such cables shall be terminated at points accessible only to qualified personnel.

   d. Communication circuits brought out of such cables, if they do not terminate in a repeater station or terminal office, shall be protected or arranged so that in the event of failure within the cable, the voltage on the communication circuit will not exceed 400 V to ground.

   e. Terminal apparatus for the power supply shall be so arranged that the live parts are inaccessible when such supply circuits are energized.

   EXCEPTION: The requirements of Rule 224B2 do not apply to communication circuits where the transmitted power does not exceed 150 W.

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Section 23. Clearances

230. General

A. Application

This section covers all clearances, including climbing spaces, involving overhead supply and communication lines.

NOTE: The more than 70 years of historical development and specification of clearances in Rules 232, 233, and 234 were reviewed for consistency among themselves and with modern practice and were appropriately revised in both concept and content for the 1990 Edition. See Appendix A.

1. Permanent and temporary installations

The clearances of Section 23 are required for permanent and temporary installations.

2. Emergency installations

The clearances required in Section 23 may be decreased for emergency installations if the following conditions are met.

NOTE: See Rule 14.

a. Open supply conductors of 0 to 750 V and supply cables meeting Rule 230C; and communication conductors and cables, guys, messengers, and neutral conductors meeting Rule 230E1 shall be suspended not less than 4.8 m (15.5 ft) above areas where trucks are expected, or 2.70 m (9 ft) above areas limited to pedestrians or restricted traffic only where vehicles are not expected during the emergency, unless Section 23 permits lesser clearances.

For the purpose of this rule, trucks are defined as any vehicle exceeding 2.5 m (8 ft) in height. Areas not subject to truck traffic are areas where truck traffic is neither normally encountered nor reasonably anticipated or is otherwise limited.

Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback, vehicles, or other mobile units exceeding 2.5 m (8 ft) in height are prohibited by regulation or permanent terrain configurations or are otherwise neither normally encountered nor reasonably anticipated or are otherwise limited.

b. Vertical clearances of open supply conductors above 750 V shall be increased above the applicable value of Rule 230A2a as appropriate for the voltage involved and the given local conditions.

c. Reductions in horizontal clearances permitted by this rule shall be in accordance with accepted good practice for the given local conditions during the term of the emergency.

d. Supply and communication cables may be laid directly on grade if they are guarded or otherwise located so that they do not unduly obstruct pedestrian or vehicular traffic and are appropriately marked. Supply cables operating above 600 V shall meet either Rule 230C or 350B.

e. No clearance is specified for areas where access is limited to qualified personnel only.

3. Measurement of clearance and spacing

Unless otherwise stated, all clearances shall be measured from surface to surface and all spacings shall be measured center to center. For clearance measurement, live metallic hardware electrically connected to line conductors shall be considered a part of the line conductors. Metallic bases of potheads, surge arresters, and similar devices shall be considered a part of the supporting structure.

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4. Rounding of calculation results

Unless otherwise specified in a table or rule within Section 23 that requires a calculation, the resultant of the calculation shall be rounded up to the same level of decimal places as the basic value shown in the rule or table, regardless of the numbers of significant digits of individual values required to be used in the calculation.

EXCEPTION: Rules or tables with values in millimeters are shown in units of 5 mm; as a result, resultants of calculations to be expressed in millimeters shall be rounded up to the next multiple of 5 mm.

EXAMPLES: If the basic value shown in a rule or table has no decimal places, such as 3 in, the resultant will be rounded up to the next whole number. If the basic value shown in the table or rule is shown as having one decimal place, such as 18.5 ft, the resultant of the calculation will be rounded up to one decimal place. If the table or rule contains a basic value expressed in two decimal places, such as 1.27 m, the resultant will be rounded up to two decimal places.

B. Ice and wind loading for clearances

1. Three general degrees of loading due to weather conditions are recognized and are designated as clearance zones 1, 2, and 3. Figure 230-1 shows the zones where these loadings apply.

NOTE: The localities are classified in the different zones according to the relative simultaneous prevalence of the wind velocity and thickness of ice that accumulates on wires. Zone 3 is for places where little, if any, ice accumulates on wires. See Appendix B.

2. Table 230-1 shows the radial thickness of ice to be used in calculating sags for clearance purposes. See applicable clearance rules in Section 23.

3. Ice and wind loads are specified in Rule 230B1.

a. Where a cable is attached to a messenger, the specified loads shall be applied to both cable and messenger.

b. In determining wind loads on a conductor or cable without ice covering, the assumed projected area shall be that of a smooth cylinder whose outside diameter is the same as that of the conductor or cable. The force coefficient (shape factor) for cylindrical surfaces is assumed to be 1.0.

NOTE: Experience has shown that as the size of multiconductor cable decreases, the actual projected area decreases, but the roughness factor increases and offsets the reduction in projected area.

c. An appropriate mathematical model shall be used to determine the wind and weight loads on ice-coated conductors and cables. In the absence of a model developed in accordance with Rule 230B5, the following mathematical model shall be used:

(1) On a conductor, lashed cable, or multiple-conductor cable, the coating of ice shall be considered to be a hollow cylinder touching the outer strands of the conductor or the outer circumference of the lashed cable or multiple-conductor cable.

(2) On bundled conductors, the coating of ice shall be considered as individual hollow cylinders around each subconductor.

d. It is recognized that the effects of conductor stranding or of non-circular cross section may result in wind and ice loadings more or less than those calculated according to assumptions stated in Rules 230B3b and 230B3c. No reduction in these loadings is permitted unless testing or a qualified engineering study justifies a reduction.

4. Table 230-2 shows the radial thickness of ice, wind pressures, temperatures, and additive constants to be used in calculating inelastic deformation.

The load components shall be determined as follows:

a. Vertical load component

The vertical load on a wire, conductor, or messenger shall be its own weight plus the weight of conductors, spacers, or equipment that it supports, ice covered where required by Rule 230B1 and Table 230-2.

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b. Horizontal load component

The horizontal load shall be the horizontal wind pressure determined under Rule 230B1 and Table 230-2, applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors, spacers, or equipment that it supports, ice covered where required by Rule 230B1 and Table 230-2.

c. Total load

The total load on each wire, conductor, or messenger shall be the resultant of components in a) and b) above, calculated at the applicable temperature in Table 230-2, plus the corresponding additive constant in Table 230-2.

5. Final sag calculations shall include the effects of inelastic deformation due to both (a) initial and subsequent combined ice and wind loading, and (b) long-term material deformation (creep). See applicable sag definitions. Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

C. Supply cables

For clearance purposes, supply cables, including splices and taps, conforming to any of the following requirements are permitted lesser clearances than open conductors of the same voltage. Cables should be capable of withstanding tests applied in accordance with an applicable standard.

1. Cables that are supported on or cabled together with an effectively grounded bare messenger or neutral, or with multiple concentric neutral conductors, where any associated neutral conductor(s) meet(s) the requirements of Rule 230E1 and where the cables also meet one of the following:

   a. Cables of any voltage having an effectively grounded continuous metal sheath or shield

   b. Cables designed to operate on a multi-grounded system at 22 kV or less and having semiconducting insulation shielding in combination with suitable metallic drainage

2. Cables of any voltage, not included in Rule 230C1, covered with a continuous auxiliary semiconducting shield in combination with suitable metallic drainage and supported on and cabled together with an effectively grounded bare messenger.

3. Insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral.

D. Covered conductors

Covered conductors shall be considered bare conductors for all clearance requirements except that clearance between conductors of the same or different circuits, including grounded conductors, may be reduced below the requirements for open conductors when the conductors are owned, operated, or maintained by the same party and when the conductor covering provides sufficient dielectric strength to limit the likelihood of a short circuit in case of momentary contact between conductors or between conductors and the grounded conductor. Intermediate spacers may be used to maintain conductor clearance and to provide support.

E. Neutral conductors

1. Neutral conductors that are effectively grounded throughout their length and associated with circuits of 0 to 22 kV to ground may have the same clearances as guys and messengers.

2. All other neutral conductors of supply circuits shall have the same clearances as the phase conductors of the circuit with which they are associated.

F. Fiber-optic cable

1. Fiber-optic —supply cable

   a. Cable defined as "fiber-optic—supply" supported on a messenger that is effectively grounded throughout its length shall have the same clearance from communications facilities as required for a neutral conductor meeting Rule 230E1.

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b. Cable defined as "fiber-optic—supply" that is entirely dielectric, or supported on a messenger that is entirely dielectric, shall have the same clearance from communications facilities as required for a neutral conductor meeting Rule 230E1.

c. Fiber-optic—supply cables supported on or within messengers not meeting Rule 230F1a or 230F1b shall have the same clearances from communications facilities required for such messengers.

d. Fiber-optic—supply cables supported on or within a conductor(s), or containing a conductor(s) or cable sheath(s) within the fiber-optic cable assembly shall have the same clearances from communications facilities required for such conductors. Such clearance shall be not less than that required under Rule 230F1a, 230F1b, or 230F1c, as applicable.

e. Fiber-optic—supply cables meeting Rule 224A3 are considered to be communication cables when located in the communication space.

2. Fiber-optic—communication cable

Cable defined as "fiber-optic—communication" shall have the same clearance from supply facilities as required for a communication messenger.

G. Alternating- and direct-current circuits

The rules of this section are applicable to both ac and dc circuits. For dc circuits, the clearance requirements shall be the same as those for ac circuits having the same crest voltage to ground.

NOTE: Although the corresponding crest voltage for a common sinusoidal ac circuit may be calculated by multiplying its rms value by 1.414 (square root of 2), this may not be appropriate for other type ac circuits. An example of the latter is represented by non-sinusoidal power supplies such as used in some coaxial cable type communication systems.

H. Constant-current circuits

The clearances for constant-current circuits (such as series lighting circuits) shall be determined on the basis of their normal full-load voltage.

I. Maintenance of clearances and spacings

The clearances and spacing required shall be maintained at the values and under the conditions specified in Section 23 of the applicable edition. The clearances of Section 23 are not intended to be maintained during the course of or as a result of abnormal events such as, but not limited to, actions of others or weather events in excess of those described under Section 23.

NOTE: See Rule 13 to determine the applicable edition.

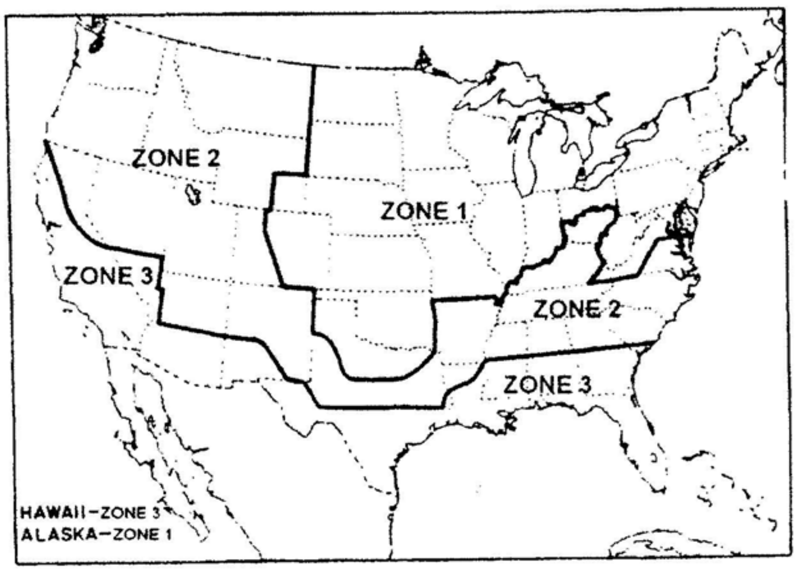

Figure 230-1—Clearance zone map of the United States

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235. Clearance for wires, conductors, or cables carried on the same supporting structure

A. Application of rule

1. Multiconductor wires or cables

   Cables, and duplex, triple, or paired conductors supported on insulators or messengers meeting Rule 230C or 230D, whether single or grouped, for the purposes of this rule are considered single conductors even though they may contain individual conductors not of the same phase or polarity.

2. Conductors supported by messengers or span wires

   Clearances between individual wires, conductors, or cables supported by the same messenger, or between any group and its supporting messenger, or between a trolley feeder, supply conductor, or communication conductor, and their respective supporting span wires, are not subject to the provisions of this rule.

3. Line conductors of different circuits

   a. Unless otherwise stated, the voltage between line conductors of different circuits shall be the greater of the following:

      (1) The phasor difference between the conductors involved

      NOTE: A phasor relationship of 180° is considered appropriate where the actual phasor relationship is unknown.

      (2) The phase-to-ground voltage of the higher-voltage circuit

   b. When the circuits have the same nominal voltage, either circuit may be considered to be the higher-voltage circuit.

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B. Horizontal clearance between line conductors

1. Fixed supports

Line conductors attached to fixed supports shall have horizontal clearances from each other not less than the larger value required by either Rule 235B1a or 235B1b for the situation concerned. Voltage is between the two conductors for which the clearance is being determined except for railway feeders, which are to ground.

EXCEPTION 1: The pin spacing at buckarm construction may be reduced as specified in Rule 236F to provide climbing space.

EXCEPTION 2: Grade N need meet only the requirements of Rule 235B1a.

EXCEPTION 3: These clearances do not apply to cables meeting Rule 230C or covered conductors of the same circuit meeting Rule 230D.

EXCEPTION 4: For voltages to ground exceeding 98 kV ac or 139 kV dc, clearances less than those required by a and b below are permitted for systems with known maximum switching-surge factors. (See Rule 235B3.)

a. Horizontal clearance between line conductors of the same or different circuits

Clearances shall be not less than those given in Table 235-1.

b. Clearance according to sags

The clearance at the supports of line conductors of the same or different circuits of Grade B or C in no case shall be less than the values given by the following formulas, at a conductor temperature of 15 °C (60 °F), at final unloaded sag, no wind. For the purpose of this rule, the line conductor clearances are between the surfaces of the conductors only, not including armor rods, tie wires, or other fasteners. The requirements of Rule 235B1a apply if they give a greater clearance than this rule.

EXCEPTION: No requirement is specified for clearance between conductors of the same circuit when rated above 50 kV.

In the following, S is the apparent sag in millimeters of the conductor having the greater sag, and the clearance is in millimeters. Voltage (kV) is the voltage between the conductors.

(1) For line conductors smaller than AWG No. 2: clearance = 7.6 mm/(kV) + $20.4\sqrt{S-610}$. (Table 235-2 shows selected values up to 46 kV.)

(2) For line conductors of AWG No. 2 or larger: clearance = 7.6 mm/(kV) + 8 $\sqrt{(2.12S)}$. (Table 235-3 shows selected values up to 46 kV.)

(3) For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235B3.

(4) The clearance for voltages exceeding 50 kV specified in Rule 235B1b(1) and (2) shall be increased 3% for each 300 m in excess of 1000 m above mean sea level. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

In the following, S is the apparent sag in inches of the conductor having the greater sag, and the clearance is in inches. Voltage (kV) is the voltage between the conductors.

(1) For line conductors smaller than AWG No. 2: clearance = 0.3 in/(kV) + $4.04\sqrt{S-24}$. (Table 235-2 shows selected values up to 46 kV.)

(2) For line conductors of AWG No. 2 or larger: clearance = 0.3 in/(kV) + $8\sqrt{S/12}$. (Table 235-3 shows selected values up to 46 kV.)

(3) For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235B3.

(4) The clearance for voltages exceeding 50 kV specified in Rule 235B1b(1) and (2) shall be increased 3% for each 1000 ft in excess of 3300 ft above mean sea level. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

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2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance between conductors shall be increased so that one string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235B1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft^2) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft^2) wind in areas sheltered by buildings, terrains, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the horizontal clearance between two wires, conductors, or cables.

3. Alternate clearances for different circuits where one or both circuits exceed 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235B1 and 235B2 may be reduced for circuits with known switching-surge factors but shall be not less than the clearances derived from the following computations. For these computations, communication conductors and cables, guys, messengers, neutral conductors meeting Rule 230E1, and supply cables meeting Rule 230C1 shall be considered line conductors at zero voltage.

a. Clearance

(1) The alternate clearance shall be maintained under the expected loading conditions and shall be not less than the electrical clearance between conductors of different circuits computed from the following equation. For convenience, clearances for typical system voltages are shown in Table 235-4.

$$D = 1.00\left[\frac{V_{L-L}\cdot(PU)\cdot a}{500K}\right]^{1.667} b \qquad \text{(m)}$$

$$D = 3.28\left[\frac{V_{L-L}\cdot(PU)\cdot a}{500K}\right]^{1.667} b \qquad \text{(ft)}$$

where

V_{L-L} = maximum ac crest operating voltage in kilovolts between phases of different circuits or maximum dc operating voltage between poles of different circuits. If the phases are of the same phase and voltage magnitude, one phase conductor shall be considered grounded

PU = maximum switching-surge factor expressed in per-unit peak operating voltage between phases of different circuits and defined as a switching surge level between phases for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater

a = 1.15, the allowance for three standard deviations

b = 1.03, the allowance for nonstandard atmospheric conditions

K = 1.4, the configuration factor for a conductor-to-conductor gap

(2) The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

b. Limit

The clearance derived from Rule 235B3a shall not be less than the basic clearances given in Table 235-1 computed for 169 kV ac.

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C. Vertical clearance between line conductors

All line wires, conductors, and cables located at different levels on the same supporting structure shall have vertical clearances not less than the following:

1. Basic clearance for conductors of same or different circuits

   a. Between supply lines of the same or different circuits

      The clearance requirements given in Table 235-5 shall apply to supply line wires, conductors, or cables of 0 to 50 kV attached to supports. No value is specified for clearances between conductors of the same circuit exceeding 50 kV, between cables meeting Rule 230C3 and neutral conductors meeting Rule 230E1 of the same utility, or between ungrounded open supply conductors 0 to 50 kV of the same phase and circuit of the same utility.

   b. Between supply lines and communication lines

      The clearance requirements given in Table 235-5 shall apply.

   c. Between communication lines located in the communication space

      The clearance and spacing requirements of Rule 235H shall apply to communication lines located in the communication space.

   d. Between communication lines located in the supply space

      The clearance requirements of Table 235-5 shall apply to communication lines located in the supply space.

   EXCEPTION 1: Line wires, conductors, or cables on vertical racks or separate brackets placed vertically and meeting the requirements of Rule 235G may have spacings as specified in that rule.

   EXCEPTION 2: Where communication service drops cross under supply conductors on a common crossing structure, the clearance between the communication conductor and an effectively grounded supply conductor may be reduced to 100 mm (4 in) provided the clearance between the communication conductor and supply conductors not effectively grounded meets the requirements of Rule 235C as appropriate.

   EXCEPTION 3: Supply service drops of 0 to 750 V running above and parallel to communication service drops may have a clearance of not less than 300 mm (12 in) at any point in the span including the point of their attachment to the building or structure being served provided that the nongrounded conductors are insulated and that the clearance as otherwise required by this rule is maintained between the two service drops at the pole.

   EXCEPTION 4: This rule does not apply to conductors of the same circuit meeting Rule 230D.

2. Additional clearances

   Greater clearances than those required (by Rule 235C1) and given in Table 235-5 shall be provided under the following conditions. The increases are cumulative where more than one is applicable.

   a. Voltage related clearances

      (1) For voltages between 50 and 814 kV, the clearance between line wires, conductors, or cables of different circuits shall be increased 10 mm (0.4 in) per kilovolt in excess of 50 kV.

         EXCEPTION: For voltages to ground exceeding 98 kV ac or 139 kV dc, clearances less than those required above are permitted for systems with known switching-surge factors. (See Rule 235C3.)

         EXAMPLES: Calculations of clearances required by Rule 235C2a for a 69.7 kV maximum operating voltage phase-to-ground conductor above a 7.2 kV phase-to-ground conductor, assuming conductors are 180° out of phase.

         Rule 253C2a: Clearance required at support

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(a) Same utility [basic clearance = 0.41 m (16 in)]:

SI units: {0.41 + [(50 − 8.7) × 0.01]} + [(69.7 + 7.2 − 50) × 0.01] = 1.09 m. No rounding required in this example.

Customary units: {16.0 + [(50 − 8.7) × 0.4]} + [(69.7 + 7.2 − 50) × 0.4] = 43.3 in. Round up to 44 in.

(b) Different utilities [basic clearance = 1.00 m (40 in)]:

SI units: {1.00 + [(50 − 8.7) × 0.01]} + [(69.7 + 7.2 − 50) × 0.01] = 1.68 m. No rounding required in this example.

Customary units: {40.0 + [(50 − 8.7) × 0.4]} + [(69.7 + 7.2 − 50) × 0.4] = 67.3 in. Round up to 68 in.

(2) The increase in clearance for voltages in excess of 50 kV specified in Rule 235C2a(1) shall be increased 3% for each 300 m (1000 ft) in excess of 1000 m (3300 ft) above mean sea level.

(3) All clearances for lines over 50 kV shall be based on the maximum operating voltage.

(4) No value is specified for clearances between conductors of the same circuit.

b. Sag-related clearances

(1) Line wires, conductors, and cables supported at different levels on the same structures shall have vertical clearances at the supporting structures so adjusted that the clearance at any point in the span shall be not less than any of the following:

(a) For voltages less than 50 kV between conductors, 75% of that required at the supports by Table 235-5.

EXCEPTION 1: Neutral conductors meeting Rule 230E1, fiber-optic supply cables meeting Rule 230F1a or 230F1b, insulated communication cables located in the supply space and supported by an effectively grounded messenger, and supply cables meeting Rule 230C1 (including their support brackets) in the supply space running above and parallel to communication cables in the communications space where the supply neutral or messenger is bonded to the communication messenger at intervals specified in Rule 92C, may have a clearance of 300 mm (12 in) at any point in the span provided that a clearance of 0.75 m (30 in) is maintained between the supply space conductors and cables and the communication space cables at the supporting poles. Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

EXCEPTION 2: When all parties involved are in agreement, for supply conductors of different utilities, vertical clearance at any point in the span need not exceed 75% of the values required at the supports for the same utility by Table 235-5.

(b) For voltages more than 50 kV between conductors, use the value as calculated by the following appropriate formula:

If the basic value is 0.41 m (16 in): 0.62 m (24.4 in) plus 10 mm (0.4 in) per kV in excess of 50 kV.

If the basic value is 1.0 m (40 in):1.08 m (42.4 in) plus 10 mm (0.4 in) per kV in excess of 50 kV.

EXAMPLES: Calculations of clearances required by Rule 235C2b(1)(b) for a 69.7 kV maximum operating voltage phase-to-ground conductor above a 7.2 kV phase-to-ground conductor, assuming conductors are 180 degrees out of phase.

Rule 253C2b(1)(b): Clearance required at any point in the span

(i) Same utility [basic clearance = 0.41m (16 in)]:

SI units: {0.41 + [(50 − 8.7) × 0.01]} × 0.75 + [(69.7 + 7.2 − 50) × 0.01] = 0.89 m. No rounding required in this example.

Customary units: {16.0 + [(50 − 8.7) × 0.4]} × 0.75 + [(69.7 + 7.2 − 50) × 0.4] 35.2 in. Round up to 36 in.

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(ii) Different utilities [basic clearance = 1.00 m (40 in)]:

SI units: {1.00 + [(50 − 8.7) × 0.01]} × 0.75 + [(69.7 + 7.2 − 50) × 0.01] = 1.33 m. No rounding required in this example.

Customary units: {40.0 + [(50 − 8.7) × 0.4]} × 0.75 + [(69.7 + 7.2 − 50) × 0.4] = 53.2 in. Round up to 54 in.

(c) For purposes of this determination the vertical clearances required in Rule 235C2b(1)(a) and (b) apply to the following conductor temperature and loading conditions whichever produces the greater vertical clearance at the structure when:

i. The upper conductor is at final sag at 120 °F or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, or

ii. The upper conductor is at final sag at 32 °F with the radial thickness of ice, if any, specified in Table 230-1 for the zone concerned and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, and without ice loading.

EXCEPTION: Rule 235C2b(1)(c) does not apply to conductors of the same utility when the conductors are the same size and type, and are installed at the same sag and tension. However, where experience in an area has shown that different ice conditions do occur between the upper and lower conductors, then Rule 235C2b(1)(c)ii shall apply.

(2) Sags should be readjusted when necessary to accomplish the foregoing, but not reduced sufficiently to conflict with the requirements of Rule 261H1. In cases where conductors of different sizes are strung to the same sag for the sake of appearance or to maintain unreduced clearance throughout storms, the chosen sag should be such as will keep the smallest conductor involved in compliance with the sag requirements of Rule 261H1.

(3) For span lengths in excess of 45 m (150 ft), vertical clearance at the structure between open supply conductors and communication cables or conductors shall be adjusted so that under conditions of conductor temperature of 15 °C (60 °F), no wind displacement and final unloaded sag, no open supply conductor of over 750 V but less than 50 kV shall be lower in the span than a straight line joining the points of support of the highest communication cable or conductor.

EXCEPTION: Effectively grounded supply conductors associated with systems of 50 kV or less need meet only the provisions of Rule 235C2b(1).

3. Alternate clearances for different circuits where one or both exceed 98 kV ac, or 139 kV dc to ground

The clearances specified in Rules 235C1 and 235C2 may be reduced for circuits with known switching-surge factors, but shall not be less than the crossing clearances required by Rule 233C3.

4. Communication worker safety zone

The clearances specified in Rules 235C and 238 create a communication worker safety zone between the facilities located in the supply space and facilities located in the communication space, both at the structure and in the span between structures. Except as allowed by Rules 238C, 238D, and 239, no supply or communication facility shall be located in the communication worker safety zone.

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D. Diagonal clearance between line wires, conductors, and cables located at different levels on the same supporting structure

No wire, conductor, or cable may be closer to any other wire, conductor, or cable than defined by the dashed line in Figure 235-1, where V and H are determined in accordance with other parts of Rule 235.

E. Clearances in any direction from line conductors to supports, and to vertical or lateral conductors, span, or guy wires attached to the same support

1. Fixed supports

Clearances shall be not less than those given in Table 235-6.

NOTE 1: For clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure, see Rule 235I.

NOTE 2: For antennas in the communication space, see Rule 236D1.

EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required by Table 235-6 are permitted for systems with known switching-surge factor. (See Rule 235E3.)

2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance shall be increased so that the string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235E1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft^2) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft^2) wind in areas sheltered by buildings, terrain, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the clearance.

3. Alternate clearances for voltages exceeding 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235E1 and 235E2 may be reduced for circuits with known switching-surge factors but shall not be less than the following:

a. Alternate clearances to anchor guys, surge-protection wires, and vertical or lateral conductors

The alternate clearances shall be not less than the crossing clearances required by Rule 233B2 and Rules 233C3a and 233C3b for the conductor voltages concerned. For the purpose of this rule, anchor guys and surge-protection wires shall be assumed to be at ground potential. The limits of Rule 235E3b(2) shall apply to the clearance derived from Rules 233C3a and 233C3b.

b. Alternate clearance to surface of support arms and structures

(1) Alternate clearance

(a) Basic computation

The alternate clearances shall be maintained under the expected loading conditions and shall be not less than the electrical clearances computed from the following equation. For convenience, clearances for typical system voltages are shown in Table 235-7.

$$D = 1.00\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(m)}$$

$$D = 39.37\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(in)}$$

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where

V = maximum ac crest operating voltage to ground or maximum dc operating voltage to ground in kilovolts

PU = maximum switching-surge factor expressed in per-unit peak voltage to ground and defined as a switching-surge level for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater

a = 1.15, the allowance for three standard deviations with fixed insulator supports

= 1.05, the allowance for one standard deviation with free-swinging manipulators

b = 1.03, the allowance for nonstandard atmospheric conditions

K = 1.2, the configuration factor for conductor-to-tower window

(b) Atmospheric correction

The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

(2) Limits

The alternate clearance shall not be less than the clearance of Table 235-6 for 169 kV ac. The alternate clearance shall be checked for adequacy of clearance to workers and increased, if necessary, where work is to be done on the structure while the circuit is energized. (Also see Part 4.)

F. Clearances between circuits of different voltage classifications located in the supply space on the same support arm

Circuits of any one voltage classification (0 to 750 V, over 750 V to 8.7 kV, over 8.7 kV to 22 kV, and over 22 kV to 50 kV) may be maintained in the supply space on the same support arm with supply circuits of the next consecutive voltage classification only under one or more of the five following conditions. For purposes of these determinations, a neutral conductor shall be considered as having the same voltage classification as the circuit with which it is associated:

1. If they occupy positions on opposite sides of the structure
2. If in bridge-arm or sidearm construction, the clearance is not less than the climbing space required for the higher voltage concerned and provided for in Rule 236
3. If the higher-voltage conductors occupy the outer positions and the lower-voltage conductors occupy the inner positions
4. If series lighting or similar supply circuits are ordinarily dead during periods of work on or above the support arm concerned
5. If the two circuits concerned are communication circuits (located in the supply space in accordance with Rule 224A), or one circuit is such a communication circuit and the other is a supply circuit of less than 8.7 kV, provided they are installed as specified in Rule 235F1 or 235F2

G. Conductor spacing: vertical racks or separate brackets

Conductors or cables may be carried on vertical racks or separate brackets other than wood placed vertically on one side of the structure and securely attached thereto with less clearance between the wires, conductors, or cables than specified in Rule 235C if all the following conditions are met:

1. All wires, conductors, and cables are owned and maintained by the same utility, unless by agreement between all parties involved.
2. The voltage shall be not more than 750 V, except supply cables and conductors meeting Rule 230C1 or 230C2, which may carry any voltage.

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3. Conductors shall be arranged so that the vertical spacing shall be not less than that specified in Table 235-8 under the conditions specified in Rule 235C2b(1)(c)
4. A supporting neutral conductor of a supply cable meeting Rule 230C3 or an effectively grounded messenger of a supply cable meeting Rule 230C1 or 230C2 may attach to the same insulator or bracket as a neutral conductor meeting Rule 230E1, so long as the clearances of Table 235-8 are maintained in mid-span and the insulated energized conductors are positioned away from the open supply neutral at the attachment.

H. Clearance and spacing between communication conductors, cables, and equipment

1. The spacing between messengers supporting communication cables should be not less than 300 mm (12 in) except by agreement between the parties involved.
2. The clearances between the conductors, cables, and equipment of one communication utility to those of another, anywhere in the span, shall be not less than 100 mm (4 in), except by agreement between the parties involved.

I. Clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure

1. General

   Communication antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space in accordance with the applicable rules of Sections 42 and 44. See also Rule 224A.

2. Communication antenna

   The clearance between a communication antenna operated at a radio frequency of 3 kHz to 300 GHz and a supply line conductor shall be not less than the value given in Table 235-6, row 1b.

   NOTE 1: The antenna functions as a rigid, vertical, or lateral open wire communication conductor.

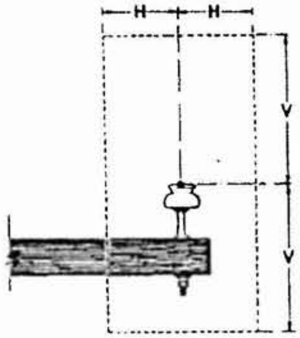
   NOTE 2: See Rule 420Q.

3. Equipment case that supports a communication antenna

   The clearance between an equipment case that supports a communication antenna and a supply line conductor shall be not less than the value given in Table 235-6, Row 4a.

4. Vertical or lateral communication conductors and cables attached to a communication antenna

   The clearance between a supply line conductor and the vertical or lateral communication conductor and cable attached to a communication antenna shall be not less than the value given in Rule 239.



V = Vertical clearance

H = Horizontal clearance

Figure 235-1—Clearance diagram for energized conductor

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m

Table 235-5— Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels	Conductors and cables usually at upper levels			
	Supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (m)	Open supply conductors		
		0 to 8.7 kV [10] (m)	Over 8.7 to 50 kV	
			Same utility [1] (m)	Different utilities [1] (m)
1. Communication conductors and cables				
a. Located in the communication space	1.00 [1] [3]	1.00	1.00	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
b. Located in the supply space	0.41 [3] [8]	0.41 [8]	1.00 [8]	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
2. Supply conductors and cables				
a. Open conductors 0 to 750 V; supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1 [10]	0.41 [2]	0.41 [2]	0.41 plus 0.01 per kV [5] in excess of 8.7 kV	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
b. Open conductors over 750 V to 8.7 kV		0.41 [2]	0.41 plus 0.01 per kV [2] [5] in excess of 8.7 kV	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
c. Open conductors over 8.7 to 22 kV				
(1) If worked on energized with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors			0.41 plus 0.01 per kV [5]	1.00 plus 0.01 per kV [5]

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Table 235-5— *(continued)*
Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels	Conductors and cables usually at upper levels			
	Supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (m)	Open supply conductors		
		0 to 8.7 kV[11] (m)	Over 8.7 to 50 kV	
			Same utility[7] (m)	Different utilities[2] (m)
(2) If not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires			0.41 plus 0.01 per kV [3][6] in excess of 8.7 kV	0.41 plus 0.01 per kV [3][6] in excess of 8.7 kV
d. Open conductors exceeding 22 kV, but not exceeding 50 kV			0.41 plus 0.01 per kV [3][6] in excess of 8.7 kV	1.00 plus 0.01 per kV [3][6] in excess of 8.7 kV

[1] Where supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run below communication circuits in accordance with Rule 220B2, the clearance may be reduced to 0.41 m.

[2] Where conductors are operated by different utilities, a vertical clearance of not less than 1.00 m is recommended.

[3] These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

[4] May be reduced to 0.41 m where conductors are not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires.

[5] May be reduced to 30 in for supply neutrals meeting Rule 230E1, fiber-optic supply cables on an effectively grounded messenger meeting Rule 230F1a, entirely dielectric fiber-optic supply cables meeting Rule 230F1b, insulated communication cables located in the supply space and supported by an effectively grounded messenger, and cables meeting Rule 230C1 where the supply neutral or messenger is bonded to the communication messenger. Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

[6] The greater of phasor difference or phase-to-ground voltage; see Rule 235A3.

[7] See examples of calculations in Rules 235C2a and 235C2b.

[8] Not used in this edition.

[9] No clearance is specified between neutral conductors meeting Rule 230E1 and insulated communication cables located in the supply space and supported by an effectively grounded messenger.

[10] No clearance is specified between fiber-optic supply cables meeting Rule 230F1b and supply cables and conductors.

[11] Does not include neutral conductors meeting Rule 230E1.

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in

Table 235-5— Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels	Conductors and cables usually at upper levels			
	Supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (in)	Open supply conductors		
		0 to 8.7 kV [10] (in)	Over 8.7 to 50 kV	
			Same utility [7] (in)	Different utilities [7] (in)
1. Communication conductors and cables				
a. Located in the communication space	40 [1] [5]	40	40	40 plus 0.4 per kV [6] in excess of 8.7 kV
b. Located in the supply space	16 [1] [8]	16 [8]	40 [8]	40 plus 0.4 per kV [6] in excess of 8.7 kV
2. Supply conductors and cables				
a. Open conductors 0 to 750 V; supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1 [9]	16 [9]	16 [7]	16 plus 0.4 per kV [6] in excess of 8.7 kV	40 plus 0.4 per kV [6] in excess of 8.7 kV
b. Open conductors over 750 V to 8.7 kV		16 [2]	16 plus 0.4 per kV [4] [6] in excess of 8.7 kV	40 plus 0.4 per kV [6] in excess of 8.7 kV
c. Open conductors over 8.7 to 22 kV				
(1) If worked on energized with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors			16 plus 0.4 per kV [6] in excess of 8.7 kV	40 plus 0.4 per kV [6] in excess of 8.7 kV

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in

Table 235-5— *(continued)*
Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels	Conductors and cables usually at upper levels			
	Supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (in)	Open supply conductors		
		0 to 8.7 kV ⑪ (in)	Over 8.7 to 50 kV	
			Same utility ⑦ (in)	Different utilities ② (in)
(2) If not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires			16 plus 0.4 per kV ③ ⑥ in excess of 8.7 kV	16 plus 0.4 per kV ③ ⑥ in excess of 8.7 kV
d. Open conductors exceeding 22 kV, but not exceeding 50 kV			16 plus 0.4 per kV ③ ⑥ in excess of 8.7 kV	40 plus 0.4 per kV ③ ⑥ in excess of 8.7 kV

①Where supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run below communication circuits in accordance with Rule 220B2, the clearance may be reduced to 16 in.

②Where conductors are operated by different utilities, a vertical clearance of not less than 40 in is recommended.

③These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

④May be reduced to 16 in where conductors are not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live line tools not requiring line workers to go between live wires.

⑤May be reduced to 30 in for supply neutrals meeting Rule 230E1, fiber-optic supply cables on an effectively grounded messenger meeting Rule 230F1a, entirely dielectric fiber-optic supply cables meeting Rule 230F1b, insulated communication cables located in the supply space and supported by an effectively grounded messenger, and cables meeting Rule 230C1 where the supply neutral or messenger is bonded to the communication messenger. Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

⑥The greater of phasor difference or phase-to-ground voltage; see Rule 235A3.

⑦See examples of calculations in Rules 235C2a and 235C2b.

⑧Not used in this edition.

⑨No clearance is specified between neutral conductors meeting Rule 230E1 and insulated communication cables located in the supply space and supported by an effectively grounded messenger.

⑩No clearance is specified between fiber-optic supply cables meeting Rule 230F1b and supply cables and conductors.

⑪Does not include neutral conductors meeting Rule 230E1.

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of 8.7 kV or less, or 1.0 m (40 in) plus 10 mm (0.4 in) per kV over 8.7 to 50 kV. The additional clearance of Rule 235C2 is applicable when the voltage exceeds 50 kV.

EXCEPTION 1: May be reduced to 0.75 m (30 in) from supply neutrals meeting Rule 230E1, cables meeting Rule 230C1, and fiber optic-supply cables where the supply neutral or messenger is bonded to the communication messenger.

EXCEPTION 2: These clearances do not apply where the supply circuits involved are those carried in the manner specified in Rule 220B2.

G. Requirements for vertical supply conductors and cables passing through communication space on jointly used line structures

1. Guarding—General

Vertical supply conductors or cables attached to the structure shall be guarded with suitable conduit or covering from 1.0 m (40 in) above the highest communication attachment to 1.80 m (6 ft) below the lowest communication attachment, except as allowed by Rule 238D.

EXCEPTION 1: This conduit or covering may be omitted from neutral conductors meeting Rule 230E1, supply cables meeting Rule 230C1a, and jacketed multiple-conductor supply cables of 0 to 750 V, where such conductors or cable are not in the climbing space.

For the purpose of this exception, a jacketed multiple-conductor cable is a cable with a jacket enclosing the entire cable assembly.

EXCEPTION 2: This conduit or covering may be omitted from supply grounding conductors where there are no trolley or ungrounded traffic signal attachments, or ungrounded street lighting fixtures located below the communication attachment, provided:

(a) The grounding conductor is directly (metallically) connected to a conductor which forms part of an effective grounding system,

(b) The grounding conductor has no connection to supply equipment between the grounding electrode and the effectively grounded conductor unless the supply equipment has additional connections to the effectively grounded conductor, and

(c) The grounding conductor is bonded to grounded communication facilities at that structure.

2. Cables and conductors in conduit or covering

Cables and conductors of all voltages may be run in a nonmetallic conduit or covering or in a grounded metallic conduit or covering in accordance with Rule 239A1. Where a metallic conduit or covering is not bonded to grounded communications facilities at that structure, such metal conduit or covering shall have a nonmetallic covering from 1.0 m (40 in) above the highest communication attachment to 1.80 m (6 ft) below the lowest communication attachment.

3. Protection near trolley, ungrounded traffic signal, or ungrounded luminaire attachments

Vertical supply conductors or cables attached to the structure shall be guarded with suitable nonmetallic conduit or covering on structures that carry a trolley or ungrounded traffic signal attachment or an ungrounded luminaire that is attached below the communication cable. The cable shall be protected with nonmetallic covering from 1.0 m (40 in) above the highest communication wire to 1.80 m (6 ft) below the lowest trolley attachment or ungrounded luminaire fixture or ungrounded traffic signal attachment.

4. Aerial services

Where supply cables are used as aerial services, the point where such cables leave the structure shall be at least 1.0 m (40 in) above the highest or 1.0 m (40 in) below the lowest communication attachment. Within the communication space, all splices and connections in the energized phase conductors shall be insulated.

5. Clearance from through bolts and other metal objects

Vertical runs of supply conductors or cables shall have a clearance of not less than 50 mm (2 in) from exposed through bolts and other exposed metal objects attached thereto that are associated with communication line equipment.

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Section 43.
Additional rules for communications employees

430. General

Communications employees shall observe the following rules in addition to the rules contained in Section 42.

431. Approach to energized conductors or parts

A. No employee shall approach, or bring any conductive object, within the distances to any exposed energized part as listed in Table 431-1. When repairing storm damage to communication lines that are joint use with electric supply lines at that or another point, employees shall:

1. Treat all such supply and communication lines as energized to the highest voltage to which they are exposed, or
2. Assure that the supply lines involved are de-energized and grounded in accordance with Section 44.

B. Altitude correction

The distances in Table 431-1 shall be used at elevations below 3600 m (12 000 ft). Altitude correction factors as indicated in Table 441-5 shall be applied above that altitude. Altitude correction factors shall be applied only to the electrical component of the minimum approach distance.

(m)

Table 431-1—Communication work minimum approach distances
(See Rule 431 in its entirety.)

Voltage range phase-to-phase (rms)[1]	Distance to employee at altitudes from sea level to 3600 m		
0 to 50 V [2]	Not specified		
51 to 300 V [2]	Avoid contact		
301 to 750 V [2]	0.31 m		
751 V to 15 kV	0.65 m		
15.1 kV to 36 kV	0.91 m		
36.1 kV to 46 kV	1.06 m		
46.1 kV to 72.5 kV	1.22 m		
Voltage range phase-to-phase (rms)[1]	At altitudes from		
	0 to 900 m	90 to 1800 m	1801 to 3600 m
72.6 to 121 kV	1.43 m	1.50 m	1.64 m
121.1 to 169 kV	1.75 m	1.85 m	2.04 m
169.1 to 362 kV	3.70 m	3.95 m	4.48 m
362.1 to 800 kV	7.19 m	7.72 m	8.84 m

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①For single-phase lines off three-phase systems, use the phase-to-phase voltage of that system.
②For single-phase systems, use the highest voltage available.
③The data used to calculate Table 431-1(m) was derived from test data taken under standard atmospheric conditions for dry and clean insulators. Standard atmospheric conditions are defined as temperatures above freezing, wind less than 24 km per hr, and normal barometric pressure with unsaturated and uncontaminated air.

(ft)

Table 431-1—Communication work minimum approach distances

(See Rule 431 in its entirety.)

Voltage range phase-to-phase (rms)①	Distance to employee at altitudes from sea level to 12 000 ft		
0 to 50 V ②	Not specified		
51 to 300 V ②	Avoid contact		
301 to 750 V ②	1 ft-0 in		
751 V to 15 kV	2 ft-2 in		
15.1 kV to 36 kV	3 ft-0 in		
36.1 kV to 46 kV	3 ft-6 in		
46.1 kV to 72.5 kV	4 ft-0 in		
Voltage range phase-to-phase (rms)①	**At altitudes from**		
	0 to 3000 ft	**3001 to 6000 ft**	**6001 to 12 000 ft**
72.6 kV to 121 kV	4 ft-9 in	4 ft-11 in	5 ft-5 in
121.1 kV to 169 kV	5 ft-10 in	6 ft-1 in	6 ft-9 in
169.1 kV to 362 kV	12 ft-3 in	13 ft-0 in	14 ft-9 in
362.1 kV to 800 kV	23 ft-8 in	25 ft-4 in	29 ft-0 in

①For single-phase lines off three-phase systems, use the phase-to-phase voltage of that system.
②For single-phase systems, use the highest voltage available.
③The data used to calculate Table 431-1(ft) was derived from test data taken under standard atmospheric conditions for dry and clean insulators. Standard atmospheric conditions are defined as temperatures above freezing, wind less than 15 mi per hr, and normal barometric pressure with unsaturated and uncontaminated air.

432. Joint-use structures

When working on jointly used poles or structures, employees shall not approach closer than distances specified in Table 431-1 and shall not position themselves above the level of the lowest electric supply conductor exclusive of vertical runs and street lighting.

EXCEPTION: On voltages 140 kV and below, this rule does not apply where communications facilities are attached above electric supply conductors if a rigid fixed barrier has been installed between the supply and communications facilities.

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Attachment C

BB

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May 15, 2008

VIA E-MAIL

Mr. Gardner F. Gillespie, Esq.
HOGAN & HARTSON LLP
Columbia Square
555 Thirteenth Street, NW
Washington, D.C. 20004

Re: Requested Location of Violations

Dear Gardner:

In your letter dated April 24, 2008, you requested the location of the poles depicted in the photographs attached to Wil Arnett's declaration supporting Oncor's reply comments. The violations depicted in the photographs existed on poles presently owned by TWC between 2002 and the present date. The attached spreadsheet provides the locations of the violations. By providing the information, we do not agree that it is an appropriate request.

Please call me if you have any questions.

Sincerely,

Russ Campbell by: JBR

J. Russell Campbell

JRC:myr

cc: Ms. Karen Flewharty

973110.1

PPT Number	Date of Photo	Photo Number	Location
1	3/27/2008	MVC-005s	Mockingbird Lane and Forest Park
2	3/27/2008	MVC-006s	Mockingbird Lane and Forest Park
3	4/3/2002	MVC-003s	S Dallas in the vicinity of N Davis and N Hampton
4	4/3/2002	MVC-002s	S Dallas in the vicinity of N Davis and N Hampton
5	3/19/2008	MVC-332s	Cooper St, S Arlington, north of I-20
6	4/3/2002	MVC-018s	S Dallas in the vicinity of N Davis and N Hampton
7	4/11/2002	MVC-035s	SW Dallas near Cockrell Hill (Mapsco 53)
8	4/11/2002	MVC-006s	SW Dallas near Cockrell Hill (Mapsco 53)
9	4/11/2002	MVC-008s	SW Dallas near Cockrell Hill (Mapsco 53)
10	4/11/2002	MVC-010s	SW Dallas near Cockrell Hill (Mapsco 53)
11	4/11/2002	MVC-025s	SW Dallas near Cockrell Hill (Mapsco 53)
12	4/11/2002	MVC-030s	SW Dallas near Cockrell Hill (Mapsco 53)
13	N/A		No photo on this page
14	3/27/2008		Arlington, TX. Arkansas Lane and Roosevelt St
15	3/27/2008		Arlington, TX. 2800 Arkansas Lane
16	3/27/2008		Arlington, TX. Arkansas Lane and Roosevelt St
17	3/27/2008		Arlington, TX. 2800 Arkansas Lane
18	3/27/2008		Arlington, TX. 2800 Arkansas Lane
19	4/3/2008		Keist Blvd west of Walton Walker Freeway
20	4/11/2008		Arlington, TX Arkansas Lane at Bowen St at Walgreens
21	4/11/2008		Arlington, TX Arkansas Lane at Bowen St at Walgreens
22	4/3/2002	MVC-003s	S Dallas in the vicinity of N Davis and N Hampton
23	4/11/2002	MVC-027s	SW Dallas near Cockrell Hill (Mapsco 53)